Spatiotemporal variations of hermit crab (crustacea: decapoda) inhabiting rocky shore along Saurashtra coast, western coast of India

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Spatiotemporal variations in the population ecology of two dominant hermit crabs on four major shores along the Saurashtra coastline (India) off the Arabian Sea during September 2008 to August 2009 had been examined. There were no spatial and temporal variations of the population of hermit crabs in all four sampling stations. Population dynamics were slightly higher at Dwarka and Mangrol than Veraval and Kodinar coasts. Population dynamics of these species were apparently affected by anthropogenic pressure at Veraval and somewhat lesser degree at Kodinar.

[Keywords: Arabian Sea, Hermit crab, Population ecology, Spatial and Temporal variations]

Introduction

Hermit crabs represent a significant part of benthic community, where they play an important role in the marine food chain. Gastropod shells are very much necessary for hermit crabs as being the most essential factor/resource required for their existence. The distribution of the hermit crabs has been described on the basis of their habitat selectivity in the intertidal zone and has shown the occupancy of the gastropod shells which are available in the intertidal habitats. Hermit crabs have evolved to the point where they are dependent on a microhabitat as a resource, and therefore, non-availability of adequate shells causes heavy mortality of hermit crabs. Desai and Mansuri studied on the population ecology and biology of hermit crabs of South Saurashtra coastline and reported that the hermit crabs occupy gastropod shells which are available in those particular intertidal habitats. Further, the empty gastropods shells are movable objects in relation to tidal currents and therefore, hermit crabs have been reported to exploit different rocky substratum available throughout the intertidal zone. However, as empty shells are essential for hermit crabs, they occupy whatever the type of shells they get in their specific in habitat zone. Moreover, the distribution of these two species of Clibanarius was reported to be restricted to mostly supra and mid-littoral zones of the intertidal zone at research site, which conforms the observation made by Vance. Bach and Abram reported that Clibanarius sp. tend to occur mostly in higher intertidal level. Abiotic factors are mostly control the activities of these organisms. Buchanan and Stonet suggested that abiotic factors must be considered because some ecological interactions are the main cause of seasonal and spatial distribution of individuals. Each organism occupies one definitive space where the environmental and biotic conditions, are at least, the minimum necessary to propitiate its survival.

Present investigation was undertaken to study the spatial and temporal variations in the population ecology of two hermit crabs, Clibanarius nathi and Clibanarius zebra inhabiting the rocky intertidal area of South Saurashtra coastline, which is fast becoming a favourite place for mega industries.

Materials and Method

In the present study four different stations along the South Saurashtra coastline (Gujarat State, India) which differs by the types of intertidal habitat and degree of anthropogenic pressure were selected (Fig. 1). Dwarka (22° 13’ N, 68° 58’ E), Mangrol (21° 07’ N, 70° 07’ E), Veraval (21° 35’ N, 69° 36’ E) and Kodinar (20° 41’ N, 70° 46’ E) were selected for the study. Human interference to the coast is comparatively high in two areas. The intertidal belt of Dwarka consisted of large rocks and boulders which cause immense resistance to upcoming wave...
and hence, generates harsh water splash. Thus, the tearing force of the tidal wave at Dwarka is quite higher than that of other stations. The rocky intertidal belt of Mangrol is interspersed with many tide pools, puddles, crevices and small channels with occasional sandy patches. The upper portion of the intertidal belt is generally covered with an admixture of silt and sand studded with pieces of broken shells. The intertidal pools in the upper littoral zone have a thin layer of sand settled over the rocky base. The intertidal zone is wide with moderate wave action. The substratum of Veraval coast is mainly rocky with few sandy patches. The lower littoral zone of Veraval ends up at steep vertical decline towards subtidal zone. The intertidal belt of this area is not uniform and exposure of this predominantly rocky shore is not significantly long. The intertidal zone covers a distance of about 60-90 m during spring tides. The available intertidal zone of Kodinar is hard flat rocky littoral area having small sized depressions in interspersed with many rocky pools and puddles. The spray zone is covered by sand. The intertidal belt is interrupted by many small tide pools. The upper littoral zone sharply ends up at spray zone.

The distribution pattern and population ecology of hermit crab species were studied by transects method monthly for a complete year (from October 2008 to September 2009), in the rocky littoral area of South Saurashtra coastline. The Quadrates of 0.25 m$^2$ were laid at every 10-15 meters distance in the transect while following an oblique direction from upper to lower littoral zones covering maximum area at almost regular occurrence. Quadrate frequency was determined on the basis of the total length of the available intertidal area during low tide. In each littoral zone at least ten quadrates were laid. Among the ecological attributes, density (total number of individuals from all the sample plots/number of sample plots studied) and abundance (total number of individuals/number of sample plots where the individuals occurred) of \textit{C. nathi} and \textit{C. zebra} in each sampling stations were calculated\textsuperscript{15}. The obtained monthly data were integrated as seasonal data viz., post-monsoon (September to November), winter (December to February), summer (March to May) and monsoon (June to August). All collected data were subjected to different statistical analyses for their cumulative acceptability. One way ANOVA was employed to test the differences between the stations during seasons. All statistical analyses were done as per Sokal and Rohlf\textsuperscript{16}.

\section*{Results and Discussion}

Underwood and Chapman\textsuperscript{17} suggested that understanding of ecological processes in the rocky intertidal assemblages depends on better perception of spatial and temporal variations. Among this study, \textit{Clibanarius nathi} and \textit{Clibanarius zebra} were most
abundant species of Hermit crabs, studied at the selected sampling station, which inhabits different gastropod shell species\(^8\). Hermit crabs are quite commonly seen in the tide pools of intertidal area. Both the hermit crab species were found inhabiting the soft bottom and stony rocks of intertidal zone with or without algal mats. *C. nathi* was prominent species in terms of numerical abundance, found at almost all sampling sites. Its abundance was much higher than its density at all the stations (Fig. 2). Seasonal density values showed fluctuations in case of the selected species (Fig. 3). It was observed that minimum density and abundance values of both hermit crab species found during summer season, than it was increased in monsoon and maximum values observed during post-monsoon and winter seasons (Figs 3, 4). However, maximum density and abundance were observed at Mangrol during post-monsoon season. Among the two hermit crabs *C. zebra* showed least value for all the parameters studied at all the sampling station. There did not observe much variation in any ecological attributes at spatial scale. The density value of *C. zebra* was very low compared to *C. nathi* at all the sampling stations throughout the study (Fig. 2). Both the density and abundance of this species were high at almost sampling sites during post-monsoon and winter (Fig. 2).

In the case of *C. nathi* and *C. zebra*, no clear seasonal variations were observed in any of the three vertical zones (Figs. 3, 4). Present study showed irregular pattern of ecological attributes at each sampling sites. This may be to the fact that much spatial variations were also not found between the four sampling sites. Desai and Mansuri\(^7\) studied the, ecological status of *C. nathi* and *C. zebra* in this coast, studied that the density and abundance of these are totally dependent of the availability of suitable empty gastropod shells, for these hermit crab species. In few sampling sites, however, significant variation was observed in some ecological attributes of the species studied in the lower littoral zones (Table 1). This variation is essentially a spatial variation due to the variation in coast characteristic, substratum types and other such factors within stretch of coastline. It is possible that local migration towards the upper portion of middle littoral zones in order to find bigger empty gastropod shell as the animal grows\(^7\). Therefore, it can be concluded that the coastal stretches from Dwarka to Kodinar can biologically be treated as continuous coastline where ecological attributes of these two key hermit crab species did not differ significantly. Several species of hermit crabs inhabit rocky and sandy mid-to-low tide areas of intertidal zones and are found skittering about in deserted snail shell\(^9\). Since the gastropod shells influence the hermit crab populations in many ways, shell selection for them seems to be important criteria\(^5\). The hermit crabs *C. nathi* and *C. zebra* inhabiting the coast mostly occupy the empty gastropod shells of *Cerithium caeruleum, Rhinoclavis sinensis, Clypeomorus sp.*, *Murex sp.*, *Turbo intercoastalis* and *Nucella sp.* At majority of the areas in intertidal zones, both hermit crabs species showed their habitat preferences and indicated segregation of habitat selection to avoid competition for shell selection. Therefore, in such areas where individual species of the two hermit crabs were found to inhabit, *C. nathi* was observed to occupy larger size of gastropod shells available in those areas. Thus, differences between the habitat preferences by the two species of the *Clibanarius* hermit crabs inhabiting the coasts could be interpreted as an attempt made by hermit crabs towards minimization of competition. However, an overlapping or co-existence between *C. nathi* and *C. zebra* was observed at certain places in the intertidal zone. Studies on distribution and

![Fig. 2—Spatial variation in density and abundance values of *C. nathi* and *C. zebra* during the study period.](image-url)
variation in the abundance and density of various hermit crabs species during different seasons are very negligible.

The spatial distribution of marine organisms is reported to be determined by environmental factors interactions. The results suggested no significant variations in the ecological attributes like abundance and density for both the species. Thus, it is apparent that both species do not have any temporal variations in the sampling sites studied.
Conclusion

During the study period there is no significant temporal variations in the population density and abundance of *C. nathi* and *C. zebra*. The abundance was relatively high than the density values. Generally hermit crabs are mobile animal and therefore, vertical zonation did not show any much variation. However, due to nature of substratum of the intertidal area, wave action was dissimilar at all the selected stations, these spatial variations found during the entire study.
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References